



# WaterSentinel Consequence Management Strategy

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## **Executive Summary**

Early detection of a water contamination incident is only beneficial if effective response decisions can be made in a timely manner. A consequence management plan that outlines procedures for responding to a trigger from a contamination warning system (CWS) is therefore an integral component of the WaterSentinel (WS) program. Water utilities agree the sector's existing emergency planning capabilities should be enhanced, and the American Water Works Association (AWWA), a leading water industry group, has recently highlighted the role of consequence management in contamination warning systems (AWWA, 2005). Moreover, lessons learned during the implementation of analogous monitoring programs for air quality and mail delivery systems have underscored the importance of consequence management.

A robust and tested consequence management plan is a critical element of WS that should be in place prior to the initiation of monitoring and surveillance activities at the WS pilot utility. This document describes the strategy for development of a consequence management plan as part of the WS pilot.

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## Section 1.0: Introduction

Consequence management describes the actions taken in response to a threat warning generated by the WaterSentinel Contamination Warning System (WS-CWS). These actions help the utility to determine the incident's credibility; protect public health and safety; minimize economic impacts; restore essential services; decontaminate the water system; and return to normal system operation. Consequence management begins when a water system learns that a possible contamination incident has occurred, and ends with the restoration of normal system activities.

The WS consequence management plan discussed in this document aims to build upon the approach to emergency response described in EPA's *Response Protocol Toolbox* (RPTB). The RPTB helps utilities examine the credibility of a diverse set of contamination threat warnings similar to the WS-CWS triggers. Because the WS-CWS should generate threat warnings by integrating several information streams (i.e., on-line water quality monitoring, sampling and analysis, enhanced security monitoring, consumer complaint surveillance, and public health surveillance), many possible contamination events, including many false alarms, may be detected. In order to differentiate between and respond appropriately to these false threat warnings and actual contamination events, it is necessary to develop a consequence management plan that is more specific than the RPTB.

### 1.1 Project Goals

The WS consequence management strategy addresses two goals. The immediate goal is to develop a utility-specific consequence management plan for implementation by the pilot utility. This plan should govern who and what should be involved in making response decisions, and minimizing the response timeline. The consequence management plan should detail the pilot utility's response actions, along with those of the related local, state, and federal agencies that should respond to a drinking water contamination incident. In addition to serving the needs of the WS-CWS, the pilot utility consequence management plan should enhance the utility's ability to respond to other water contamination incidents.

EPA's long-term goal is to develop a general WS consequence management guidance document. This should help any utility that is implementing a CWS to develop a utility-specific consequence management plan. Because several utilities are already planning to independently develop their own CWS, this guidance should provide a framework for consistency in the development of consequence management plans, for these utilities and future WS cities.

### 1.2 General Approach

To achieve these goals, EPA plans to convene a series of workshops with the initial WS-CWS pilot utility, local organizations involved in consequence management planning, and external water and public health experts. After each workshop, EPA anticipates drafting a section of the pilot utility's consequence management plan for the utility's review.

Development of the more general WS consequence management guidance should be based on lessons learned from the implementation of the first WS-CWS pilot. A national group of stakeholders should be engaged for development of the WS consequence management guidance.

### **1.3 Document Organization**

The remaining sections of this document describe the following aspects of the WS consequence management:

- **Section 2.0: Overview of WaterSentinel Consequence Management.** This section provides an overview of consequence management and describes its elements and phases.
- **Section 3.0: Support for Development of WaterSentinel Consequence Management Documents.** This section describes the development of the WS consequence management plan and the organization of the WS consequence management guidance.
- **Section 4.0: Workshop Overview.** This section discusses the progression of the workshops and milestones anticipated before July 2006.
- **Section 5.0: References.** This section provides a bibliography of the references cited in this document.
- **Appendix A: Acronym List**

A complete glossary of terms related to event detection and the WS program is available in *WaterSentinel System Architecture* (USEPA, 2005).

## Section 2.0: Overview of WaterSentinel Consequence Management

Consequence management procedures are initiated following the detection of a ‘possible’ contamination incident as a result of WS monitoring and surveillance activities. Standardized information streams for the WS-CWS include online water quality monitoring, sampling and analysis, enhanced security monitoring, consumer complaint surveillance, and public health surveillance. Section 2.1 and Section 2.2 describe the general approach for consequence management as part of the WS program.

### 2.1 Elements of Consequence Management

Consequence management is initiated by the detection of a possible contamination incident as a result of WS monitoring and surveillance through standardized information streams including on-line water quality monitoring, sampling and analysis, enhanced security monitoring, consumer complaint surveillance, and public health surveillance. The steps initiated after knowledge of a possible contamination incident are the consequence management activities. These activities consist of three main elements:

- Credibility determination
- Response actions
- Remediation and recovery

*Credibility determination* is the process by which various information resources are used to establish whether or not the contamination threat warning is credible. Credibility determination is performed by decision-makers and responders from various organizations. The credibility determination process continues until contamination is confirmed or can be ruled out, allowing the utility to return to routine monitoring and surveillance activities.

*Response actions* are those actions taken to either gather information to establish credibility of the threat or to mitigate the impact of contamination. For example, once a possible incident is detected, a utility may review operational data, consumer complaint summaries, and security incident history; send a site characterization team to the incident location, or request information from law enforcement and public health agencies. The data gathered through these response actions are evaluated to support the credibility determination process. The results of this further evaluation may dictate a set of additional response actions, such as working closely with external laboratories, isolating portions of the drinking water distribution system, developing plans for a public health response, preparing public notification messages, and setting up an emergency operations center with other agencies. These response actions can contribute to determining the credibility of an incident and further reduce the consequences of contamination.

*Remediation and recovery* occurs once contamination is confirmed and the immediate threat to the public and property has been mitigated. This may include activating mutual aid agreements, providing an alternate water supply and non-emergency medical care, issuing long-term water use guidance to customers, and decontaminating the water system. Several of the agencies involved in the immediate contamination response may continue to work together as the utility returns to normal operation and the lessons learned from the response are integrated into existing emergency response plans (ERP).

It is important to note that these three elements of consequence management are not isolated steps. For example, while the data from initial response actions are subjected to the credibility determination process, additional response actions are taking place. Similarly, while credibility determination and

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response actions are under way, responders should already be planning for remediation and recovery so action can be taken immediately upon confirmation of contamination.

### 2.2 Phases of Consequence Management

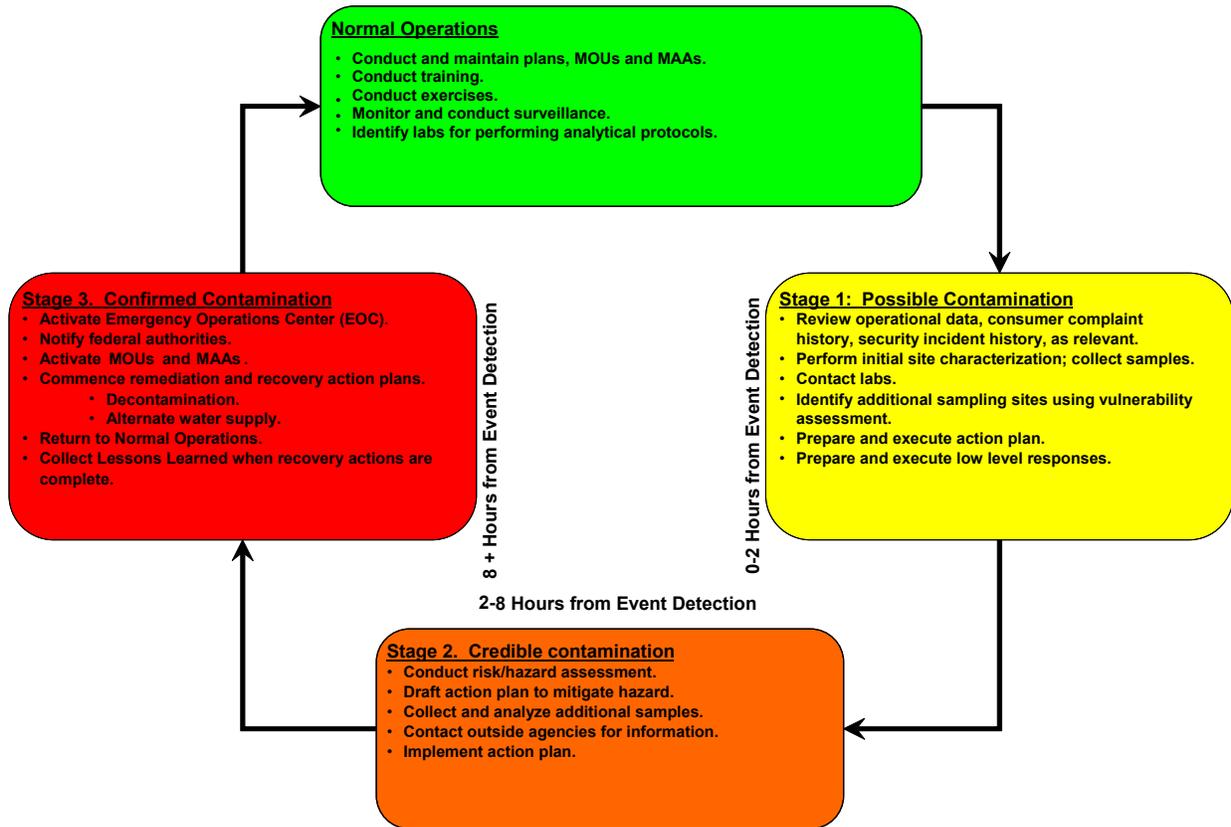
Consequence management includes three stages of contamination credibility: *possible contamination*, *credible contamination* and *confirmed contamination*. Distinct actions are associated with each stage as indicated in **Table 2-1** and **Figure 2-1**. These stages follow the same flow of response actions as those in EPA's RBTB.

**Table 2-1. Consequence Management Phases Defined for WaterSentinel**

Stage	Description	Utility Alternatives
1	Possible Contamination	Incident detection, initial credibility determination, intra-agency data gathering, and precautionary response actions
2	Credible Contamination	Additional credibility determination activities, inter-agency data gathering, response actions
3	Confirmed Contamination	Definitive evidence of contamination, inter-agency response actions, remediation and recovery actions, and return to normal operation

Figure 2-1 provides a graphical representation of the processes, flow of information, and tentative time sequence for the three stages of consequence management.

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**Figure 2-1. Contamination Determination Flowchart**

**Normal Operations.** Normal operations are the ultimate goal of consequence management. Efforts conducted under normal operations include developing and implementing plans, Memorandums of Understanding (MOUs) and Mutual Aid Agreements (MAAs) with other agencies and organizations. Utilities evaluate equipment and assets, including staffing requirements, contractors such as laboratories and subcontractors, to ensure they meet the needs of any potential contamination incident scenario. Utilities conduct exercises to prepare staff to respond to contamination threat warnings and identify areas for improvement in planning, equipment, coordination and communications. Efforts are made to integrate preparedness and operational awareness with other response agencies and organizations.

As part of “normal operations,” utilities operating a CWS should conduct routine monitoring and surveillance activities from standardized information sources. Through these monitoring and surveillance activities, an anomaly may be detected, indicating a possible contamination incident.

**Possible Contamination.** A water contamination threat is characterized as ‘possible’ if the circumstances of the threat warning indicate that there was an opportunity for contamination. Detection of an anomaly initiates credibility determination and response activities. These initial response activities are primarily internal utility actions to gather additional information on the possible contamination incident, and to prepare and execute an action plan that includes low level responses. The information

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collected can be from site characterization activities and review of operational history. In some cases, these actions can also involve external partners. For instance, the utility might request law enforcement to drive-by specific utility facilities to check for suspicious behavior. If the evaluation of this data indicates that a contamination incident is still possible, the process is elevated to a credible contamination.

The action plan would include mitigation measures. Mitigation consists of conducting risk and hazard assessments, and deploying technological and/or regulatory efforts to mitigate and reduce the level of risk. As an example, utility personnel might begin a preliminary examination of how they might isolate the portion of the water distribution system that could possibly be contaminated. Mitigation efforts are continued throughout the process and would precede any recovery actions.

**Credible Contamination.** As corroborating information is collected about possible contamination, the incident becomes credible. Internal utility notifications and response efforts are activated and contact is initiated with outside agencies, such as emergency first responders, other public health officials, law enforcement agencies, other city officials, and state drinking water authorities. Personnel, equipment, plans and procedures, are mobilized to confirm the credibility of the incident and prevent escalation of the event.

Specific actions may include reassigning staff and equipment to the field, alerting laboratories for sample analysis, system isolation, or flushing. Personnel may be assembled to isolate the contaminated portion of the water distribution system. In some cases, the utility may issue a request for support from neighboring utilities.

In addition, during this stage, utility, public health, and other relevant experts should also try to determine what contaminant might be present in the water system. They should send samples to appropriate labs for additional analysis and prepare for potential remediation and recovery. If the additional sampling and analysis indicate there is a definite contamination, the situation is elevated to confirmed contamination.

**Confirmed Contamination.** A confirmed contamination response would normally include activating the Emergency Operations Center (EOC) where coordinated response efforts can be directed and integrated with other agencies if needed. Circumstances may dictate that this action occur at an earlier time. Additional response measures, such as decontamination of affected portions of the water distribution system and facilities, disposition and/or decontamination of contaminated water, and activation of alternate water supplies would be initiated. External notifications at this stage of the incident would include public notification and information releases of usage guidance to customers and clients. Again, in some cases public notification and issuing of usage guidance may be necessary before confirmation of contamination because of the specific circumstances surrounding an event. As soon as response activities are almost completed, recovery and remediation efforts are initiated.

Recovery and remediation includes final decontamination of sources and facilities and resumption to normal operations. This includes decontaminating or disposing of contaminated water; ensuring that affected parts of the distribution system are either decontaminated or replaced; and ensuring that newly produced water is up to state and federal standards. When normal operations resume, a review of the events and response efforts would identify lessons learned in terms of how to improve detection, credibility determination, mitigation actions, and remediation and recovery actions, as well as how to best prevent future events. Lessons learned, in addition to best practices that are followed, allow for all procedures to be reviewed and updated addressing any opportunity for improvement.

## Section 3.0: Support for Development of WaterSentinel Consequence Management Documents

Developing the pilot utility consequence management plan and the more general WS consequence management guidance are two of EPA's goals for implementation of WS-CWS at a public water utility. EPA plans to engage four groups to develop these two documents as indicated in Sections 3.1 and 3.2.

### 3.1 Pilot Utility Consequence Management Plan

Three groups should be convened to develop the WS consequence management plan for the pilot utility. These groups include the following:

- **Pilot utility group.** The pilot utility group should be comprised of representatives selected by the utility from the utility's divisions: operation and distribution, laboratory and engineering, and business services and commercial services. These members are a cross-sectional representation of the utility with management responsibility, and would be involved in response actions.
- **Local group.** This group should include the organizations that should be actively involved in a local response. The local group should consist of city, county, state and regional federal agency representatives, including police and fire departments, city, county and state public health departments, city management, the state environmental department, the regional Federal Bureau of Investigation (FBI) office, and the regional EPA office. Many of the members of the local group may also be involved in other consequence management activities, and will bring this expertise to the workgroup.
- **External technical consultant group.** The external technical consultant group should provide advice to the pilot utility group and the local group during the development of the consequence management plan. They should also bring ideas generated during the workshops back to their own organizations. The consultant group should be selected based on their water or public health expertise, consequence management experience and active work on related CWS efforts.

#### 3.1.1 Organization of the WaterSentinel Consequence Management Plan

The final pilot utility consequence management plan should be arranged chronologically into three major sections, followed by appendices. The anticipated organization includes the following:

- **Section 1: Utility Organization.** This section should describe the occupational disciplines of the utility, their consequence management responsibilities, and the external partners who should participate in responding to a water contamination threat or incident. Chains of command, lines of communication, and a concept of operations should be detailed. General training for specific employee functions and overall incident coordination should be identified, but should be developed independently of the consequence management plan. Section 1 should also provide guidance on how to perform a post-incident assessment and capture lessons learned from an incident. This should allow responders to understand where the consequence management plan worked, where it did not, and how it can be improved.

These functions should be based upon the National Incident Management System ([NIMS](#)), which incorporates the Incident Command System (ICS) used widely to govern emergency response.

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NIMS is a system mandated by Homeland Security Presidential Directive-5 that provides a consistent, nationwide approach for Federal, State, local, and tribal governments; and the private sector to work effectively and efficiently together to prepare for, respond to, and recover from domestic incidents. ICS is a standardized on-scene emergency management structure that integrates the activities of various response organizations. This structure reflects the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries. ICS is the combination of facilities, equipment, personnel, procedures, and communications operating with a common organizational structure, designed to aid in the management of resources during incidents.

- **Section 2: Credibility determination process and response actions.** This section should contain protocols for assessing an incident's credibility and implementing response actions. For example, Section 2 should lay out the initial steps the pilot utility should take if an on-line water quality sensor detects an incident, including running diagnostic checks, reviewing sensor performance, and checking the nature of recent consumer feedback. The plan should provide instructions for acting on the results of this analysis, such as sending an inquiry to the public health agency, requesting that law enforcement inspect nearby facilities, and dispatching a site characterization team. Section 2 should also describe how to take precautionary actions such as isolating part of the drinking water distribution system, preparing public notification and water usage guidance, and enhancing coordination with other agencies. Finally, it should outline how data gathering for credibility determination should continue and should describe the process for elevating an incident to a confirmed contamination.
- **Section 3: Remediation and recovery actions and return to normal operation.** This section should describe methods for restoring normal water service as well as how to provide water until normal service is restored. The former includes techniques for flushing the distribution system, determining whether a contaminant has been adsorbed by pipes, and ascertaining when the distribution system has been cleaned. The latter includes a strategy for providing potable water for the general population, emergency services such as health care and fire suppression, and, if possible, business and industry.
- **Appendices.** Appendices should expand on some of the actions introduced in the document and provide more specific detail for implementation. Those actions that would be contaminant-specific (e.g., remediation and recovery actions) should be discussed in the appendices. Additional tools for collection of information in response to a trigger from the WS-CWS may also be included.

While EPA expects that the general consequence management guidance derived from the pilot utility consequence management plan should follow a similar structure, EPA recognizes that the proposed organization may need to be revised.

### 3.1.2 Implementation of Consequence Management Plan

After the pilot utility consequence management plan has been finalized, EPA anticipates sponsoring tabletop exercises and drills to practice and test the new plan. These drills should help train response agency personnel and ensure that the consequence management activities help meet the overall goals of the WS-CWS.

### **3.2 *WS Consequence Management Guidance***

After developing the pilot utility consequence management plan, EPA plans to draft WS consequence management guidance. A national group should be convened to provide feedback on this document. The national group should include representatives from utilities and public health agencies that are advanced in their efforts to protect against water-borne contamination. Prospective members include relevant representatives from select cities that have initiated work on expanded consequence management practices related to drinking water contamination. National group participants should also include representatives from the following:

- Water associations such as Association of Metropolitan Water Agencies (AMWA), American Water Works Association (AWWA), and Association of State Drinking Water Administrators (ASDWA).
- EPA Criminal Investigation Division (CID), Water Security Division (WSD), National Homeland Security Research Center (NHSRC) and National Decontamination Team (NDT)
- Federal agencies (Center for Disease Control, Department of Homeland Security, and FBI).

In addition to representatives from these agencies and organizations, some representatives from the pilot utility, local group, along with all external technical consultant group members should also be members of the national group. These individuals should provide lessons learned from the development of the pilot utility consequence management plan.

## Section 4.0: Workshop Overview

EPA plans to facilitate a series of workshops to craft a comprehensive pilot utility consequence management plan specifically for the implementation of the WS-CWS. Workshop participants should include the pilot utility group, local group, and the external technical consultant group. The workshops are intended to thoroughly engage the utility personnel in the development of the consequence management plan so that the utility may have ownership of the plan.

Each of the six planned workshops should focus on a specific issue (e.g., credibility determination, risk communication) that should be a component of the pilot utility consequence management plan.

Because other monitoring and surveillance programs may already be in place or under development in the pilot city, it is anticipated that the local public health department, police department, and other agencies should already have a consequence management infrastructure in place. EPA plans to work with workshop participants to understand the city's consequence management infrastructure and ensure that the pilot utility consequence management plan is appropriately integrated with the existing consequence management infrastructure.

### 4.1 Workshop Framework

EPA first met face-to-face with the pilot utility group in November 2005. The meeting familiarized the pilot utility group with WS contamination incident timeline analyses used to evaluate consequence and detection timelines for contamination classes. EPA solicited the pilot utility's input on likely utility responses to such situations. EPA also presented a preliminary analysis of the pilot utility's existing ERP. The focus of the analysis was to identify information that would be necessary to strengthen the pilot utility's plans for internal response and coordination with external agencies. From this initial meeting, EPA achieved two primary objectives:

- Assessment of the pilot utility's consequence management response plans and a preliminary understanding of the process used by the utility to establish the credibility of an incident; and
- Characterization of response actions that might be implemented while the incident is still being managed by the utility.

The information gained from this initial meeting is being used to establish the framework for the subsequent consequence management workshops.

#### *Subsequent Workshops*

Subsequent workshops with the utility, local, and external consultant groups should cover the generalized steps in a contamination timeline from just after incident detection through a return to normal operations. A typical outline for the workshops is presented in Section 4.2.

After the participants examine consequence management for the time period between incident detection and remediation and recovery, the pilot utility should reevaluate the process for determining the credibility of an incident detected internally. This should provide EPA and the pilot utility the time they need to assess the capabilities of other components of the WaterSentinel pilot, such as the water quality sensors and the consumer complaint tracking system. By more fully understanding these systems, the pilot utility should be able to refine its credibility determination process.

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While some workshop topics might fall outside of certain participants' areas of expertise, all participants should be invited to attend every workshop in which their group is participating. Local group members should be encouraged to identify back-up representatives in case they are unable to attend certain workshops, and to invite members of their organization to attend specific workshops if these individuals have relevant expertise. To ensure that the workshops are productive and remain on track, each workshop should include both an introductory meeting and a series of facilitated breakout sessions.

### **4.2 Timeline and Milestones**

#### **Pre-Workshop**

- Conference call with pilot utility team – Week of October 17 (complete)
- Face-to-face meeting with the pilot utility team – November 16 (complete)
- Individual calls to prospective members of local group and technical consultant group – Week of November 21 (complete)

#### **Workshops**

- **Workshop 1:** Credibility determination, timeline analyses - December 13, 2005 (planned)
- **Workshop 2:** Incident detection, initial credibility determination, intra-agency and inter-agency data gathering, and response actions (precautionary and mitigating) - January 2006 (proposed)
- **Workshop 3:** Risk Communication and Message Mapping - February 14-15, 2006, DC (planned)
- **Workshop 4:** Additional credibility determination activities, inter-agency data gathering, response actions (mitigating, and remediation and recovery), and return to normal operations - March 2006 (proposed)
- **Workshop 5:** Confirmatory evidence for credibility determination, inter-agency response actions, remediation and recovery actions, and return to normal operation - April 2006 (proposed)
- **Workshop 6:** Pre-Incident Preparedness and Incident Triggers - May 2006 (proposed)
- **Finalization:** Consequence Management Plan - Late June, Early July 2006 (proposed)

## **Section 5.0: References**

AWWA, J. Alan Roberson, P.E. and Kevin M. Morley, “Contamination Warning Systems For Water: An Approach For Providing Actionable Information To Decision-Makers” 2005.

Federal Emergency Management Agency (FEMA), National Incident Management System, 2005.  
<http://www.fema.gov/nims/>

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## Appendix A: Acronym List

AMWA	Association of Metropolitan Water Agencies
ASDWA	Association of State Drinking Water Administrators
AWWA	American Water Works Association
CID	Criminal Investigation Division
CWS	contamination warning system
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
ERP	Emergency Response Plan
FEMA	Federal Emergency Management Agency
FBI	Federal Bureau of Investigation
ICS	Incident Command System
MAA	Mutual Aid Agreements
MOU	Memorandums of Understanding
NDT	National Decontamination Team
NHSRC	National Homeland Security Research Center
NIMS	National Incident Management System
ORD	EPA Office of Research and Development
PSI	Protection Strategies Incorporated
RPTB	Response Protocol Toolbox
WS	WaterSentinel
WS-CWS	WaterSentinel contamination warning system
WSD	Water Security Division